Math 438: Mathematical Modeling

Instructor: Benjamin Ridenhour

Fall, 2021

E-mail: bridenhour@uidaho.edu
Office Hours: TTh 12:15–1:00pm (or by appt.)
Office: Brink Hall 327

Web: **https://bit.ly/31TaxS3**
Class Hours: TTh 11:00–12:15pm
Class Room: TLC 222

Course Description

The world around us is filled with processes which, at first glance, may seem quite complex. These complex processes span many fields, such as biology, physics, engineering, economics, language, literature, music, etc. Mathematical modeling presents us with a way to understand and predict the behavior of many types of systems. This first course on mathematical modeling equips students to create models to explain phenomena, fit models to relevant data, interpret models and their assumptions, and finally apply models to future problems. The book used for this course highlights certain common, real-world systems that are of interest to many STEM students. Additionally, the book provides many computational examples that can be used for undergraduate projects.

The structure of the class is as follows: We will generally read a chapter per week from our textbook (see below). Each class period will roughly be divided into 2 approximately 35 min parts: a more traditional lecture and discussion period that is then followed by in-class practicum. Participation in discussion and activities will be required; modeling is about sharing and refining ideas as well as the techniques to accomplish your goals! Student assessment will be based on participation, completing homework, 2 exams, and a final project.

The final project will be worked on throughout the semester. Students will work either individually or in teams on projects with both instructor and peer feedback. For the project, students will pick a topic of their choosing. Creation of the model, fitting of supporting data, and interpretation of the results will all be critical aspects. At the end of the semester, students will create a scientific poster of their project. Presentation of the poster will be done in class, and consist of a 10 minute explanation followed by a Q&A session.

Scheduling oddity: Dr. Ridenhour will be traveling 14–19 September, so there will be no classes those days.

COVID Policy

Please see the last page of this syllabus for documentation provided to math faculty regarding the "Healthy Vandal Policies" we will be following. If the situation changes during the semester, we will do our best to adapt. I hope that COVID will not be an issue; however, should you (or I) become ill, we will work together to figure out a reasonable resolution to the issue. I do not intend to record our class periods or post them online.

Required Materials

- *A first course in mathematical modeling*. 5^{th} edn. by FR Giordano, WP Fox, and SB Horton. Brooks/Cole: Boston.
- Functioning installations of R (**https://cran.r-project.org**) and RStudio (**https://www.rstudio.com**). Python is optional.

Prerequisites/Corequisites

Prerequisites: Math 310 (Diff. Eq.), 330 (Lin. Alg.)
Preferred: CS 120 (Comp. Sci. I)

Topics

1. Introduction to R, RStudio, and Rmd
2. Difference equations
3. Constructing mathematical models
4. Model Fitting
5. Modeling via experimentation and simulation
6. Optimization
7. Graph theory, decision theory, and game theory
8. Continuous models and their optimization
9. Dimensional analysis

Course Objectives/Learning Outcomes

Successful students will:

1. Learn how to create models that appropriate for discrete or continuous systems.

2. Gain mastery of standard methods for optimization and model fitting.
3. Be able to analyze and interpret models of various types.
4. Learn numerical and computational techniques to approximate/estimate solutions to models.

Final Exam Date

13 December (Monday), 10:15–12:15pm

Grading Policy

A typical grading scale will be used (i.e., $\geq$ 93% = A, (93,90%] = A-, (90,87%] = B+, ...). I reserve the right to curve the scale dependent on overall class scores at the end of the semester. Any curve will only ever make it easier to obtain a certain letter grade. The grade will count the assessments using the following proportions:

- **10%** of your grade will be determined by attendance/participation in class.
- **30%** of your grade will be determined by completing a final project.
- **20%** of your grade will be determined by completing homework.
- **40%** of your grade will be determined by two exams.

Healthy Vandals Policies

It is a longstanding tradition that Vandals take care of Vandals, and we all do our best to look out for the Vandal Family. These simple precautions go a long way in reducing the impact of coronavirus on our campuses and in our communities. With everyone engaging in these small actions, we can continue to participate in our vibrant campus culture where we are able to learn, live, and grow. Please bookmark the University of Idaho Covid-19 webpage and visit it often for the most up-to-date information about the U of I's response to Covid-19.

- Masks are required, effective immediately, in all university buildings, regardless of vaccination status. Faculty may wear a face shield to lead classes and must maintain 6 feet of distance while wearing the shield. These requirements will be reviewed on a periodic basis and are subject to change.
- All classes are offered in the modality listed in the catalog.
- All Vandals are highly encouraged to be vaccinated.
- COVID-19 tests are not required to attend class in person.

Additionally, faculty and students must follow the Healthy Vandal Pledge:

1. **Daily Symptom Monitoring and In-Person Class Attendance.** Evaluate your own health status before attending in-person classes and refrain from attending class in-person if you are ill, if you are experiencing any of the known symptoms of coronavirus, or if you have tested positive for COVID-19 or have been potentially exposed to someone with COVID-19.

    - Stay home if you experience any symptoms related to COVID 19 and that are not attributed to a non-infectious health condition regardless of how mild.
    - Contact your medical provider or local Idaho Public Health District for assessment of symptoms and possible COVID19 testing. Positive COVID 19 tests should be submitted via a VandalCare Report in order to make arrangements that involve classroom absences due to illness, and/or quarantine or isolation requirements directed by a medical provider.

2. **Face Masks.** All faculty, staff, students and visitors across all U of I locations must use face masks whenever indoors at any U of I buildings. You are required to wear a face mask over your nose and mouth indoors at all times.
    a. If you have a medical condition that affects your ability to comply with the face covering policy, please contact the Center for Disability Access and Resources (CDAR) to request a reasonable accommodation.
    b. Failure to wear a face covering means you will be required to leave the classroom. If a disruption to the learning experience occurs due to repeated offence and/or egregious behavior, it will be referred to the Dean of Students Office for potential code violation.